MIE346 – Design Assignment 2 (4%)

Due Date: Mar. 12th, midnight (online submission)

In class we are learning about the design of power supplies. In this assignment, your goal will be to design a power supply for use in a real application. You will pick **actual** components from real distributors, and you will estimate the size of the finished supply.

To make this a more specific problem, here are a few details:

- Your power supply will be used by a **hobbyist** (possibly by you) to power electronics projects they are working on, testing, etc. For this assignment, you will design **ONE of the following power supplies**:

- **EITHER**:

  (a) Design a **fixed-output-voltage supply.** For the voltage and current specification, you should consider a target load for your supply. We will assume that your supply should be able to power a simple microcontroller board, like the Arduino Mega 2560, at a minimum:

  http://arduino.cc/en/Main/ArduinoBoardMega2560
  http://playground.arduino.cc/Learning/WhatAdapter

  The above links (plus some research) should allow you to set reasonable current and voltage goals for your design. Some extrapolation and creative thinking on your part will be necessary for other areas of the specification (such as ripple).

  Customization: In addition to the above requirements, your supply must implement **one** of the following: EITHER (i) the design must be easy to modify (at design time, not while built/running) to output a different voltage, OR (ii) the design must be able to **simultaneously** power the above microcontroller **and** a large motor, such as: https://www.sparkfun.com/products/12115.

  OR:

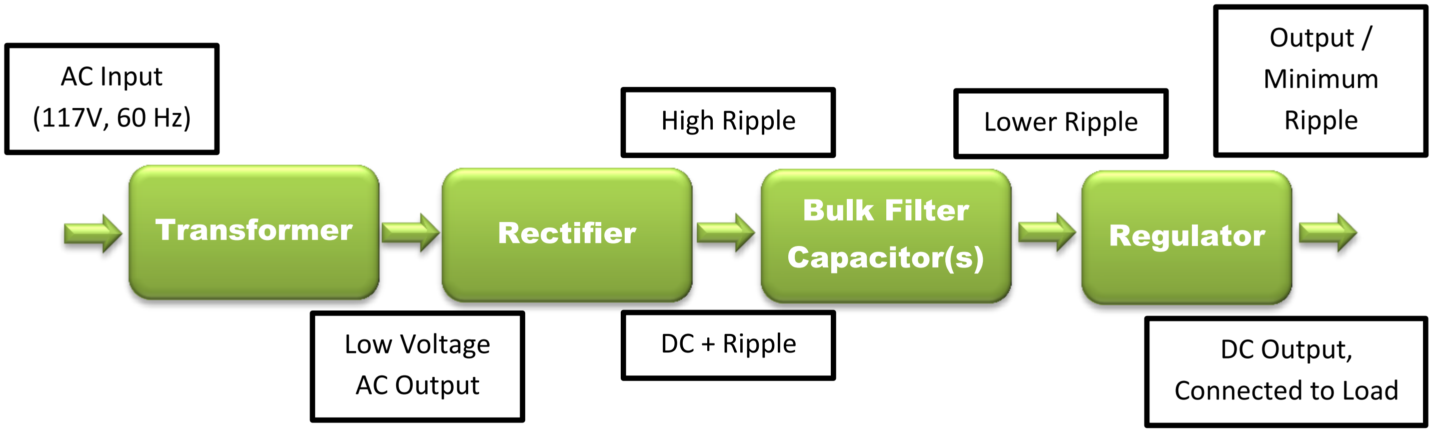
  (b) Design a **variable-output** power supply which has a **user-adjustable** output voltage. In other words, you should be able to change the output voltage while the supply is operating. This supply should be able to power **either** the microcontroller **or** the motor from option (a), but not necessarily both at the same time.

  For this option, you should consider the minimum voltage **range** needed for the target application and **exceed it by at least 25%**.

Some final tips:

- When selecting **real** components, see the selection guides that we have posted for assistance on what properties to look for, and on how to search for parts. Generally, your power supply should be as (i) **cheap**, and (ii) **efficient,** as possible.
- All part selections should be justified using calculations or reasoning related to your specification.
- **Feel free** to make improvements to the basic structure we give below, but nothing extra is needed for full marks.
- Please **clearly state** any assumptions you make about the load, the application, or other parts of the problem. In general, anything not specified in the question itself is **left to your interpretation and customization**.

Conceptual Design



Engineering Specification

1. Create a very brief engineering specification for your power supply which includes (i) nominal output voltage, (ii) load current range, and (iii) ripple specification. Be sure to make your choices consistent with the application you chose earlier – you will need to research the load for your power supply to make this specification. Some values, such as ripple voltage for either load, or current range for the microcontroller, may need to be decided partially qualitatively or based on research into common applications – for example, does a small voltage ripple matter much to a heavy mechanical motor's operation? What about a sensitive microcontroller?

Detailed Design (skipping conceptual design – assume the solution structure above is fixed)

2. Select a **real** regulator that will meet your specification from (1). You will want to consider the output voltage and current in this selection. This can either be an **integrated regulator**, or a **regulator circuit** we covered in class. If it is a circuit from class, it should be a circuit suited to the problem at hand. It should also have all components (diodes, zener diodes, capacitors, etc.) selected as **real** components.
3. Given the regulator you selected, determine the minimum input voltage required, and its ripple rejection (check its datasheet if it is an integrated type). From these values, select a capacitor value and a transformer voltage for your supply. Assume that the supply will only be used in North America (117 VAC, 60 Hz input at primary). Be careful of the **maximum** allowable input voltage for your regulator, as well. You may also need to specify the **type** of rectifier (half/full/bridge) at this point.
4. Select **real** capacitors **and** a transformer based on the results from (3). You will likely not be able to match the voltage and capacitance you calculated exactly, but close values are sufficient. Be sure to check the selection guides for each part.
5. Select a **real** diode type to implement your regulator. You should consider diode PIV, forward current limit, and any other important properties.
6. Draw your complete circuit, including all part numbers and values.

Bonus (up to 10% of assignment grade)

7. Add safety features to your design.